Robert Schuman Centre

European Unemployment:
Macroeconomic Aspects

Macroeconomic Policy and the NAIRU in European Economies

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RSC No. 97/50

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EUI Working Paper RSC No. 97/50

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EUROPEAN UNIVERSITY INSTITUTE, FLORENCE

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Macroeconomic Policy and the NAIRU in European Economies

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Paper presented at the Conference of the RSC on
European Unemployment: Macroeconomic Aspects
held at the EUI on 21-22 Nov. 1996, and organised by Michael Artis
(in collaboration with the Economics Department and the European Forum)
with financial support from the European Commission, DG V

EUI Working Paper **RSC** No. 97/50

BADIA FIESOLANA, SAN DOMENICO (FI)

©C. Giorno, A. Deserres & P. Sturm
Printed in Italy in September 1997
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I. Introduction

1. The dynamics of unemployment and inflation, as well as the interaction between these two variables, are viewed as key to understanding the impact and defining the role of macroeconomic policy. Since the early 1970s, it has generally been held that the unemployment rate can be conceptually decomposed into a structural component (the structural rate of unemployment, or SRU) and a business-cycle component. The SRU, like other "real" variables, is determined by structural and behavioural characteristics of the economy rather than by nominal (i.e. monetary) developments (Friedman, 1968)[1]. Moreover, an attempt to use aggregate demand management policy to hold the unemployment rate permanently below (above) the SRU would result in accelerating inflation (disinflation).

2. This latter characteristic led to use of the term "non-accelerating inflation rate of unemployment", or NAIRU, to describe the structural rate of unemployment. In this view, inflation dynamics are governed by the gap between the NAIRU and the actual unemployment rate: reducing the unemployment rate below the NAIRU, for example, will increase the inflation rate. In this sense, there is a trade-off between inflation and unemployment; but this trade-off is not permanent - the unemployment gap will eventually close and the final outcome will be the same unemployment rate (the NAIRU, which depends only on real variables, not on inflation) at a higher inflation rate, i.e., there is no long-run inflation-unemployment trade-off.

3. Both theoretical considerations and empirical research suggest that wage and price inflation depend not only on the gap between the unemployment rate and the NAIRU but also on the change in the gap. In this case, a distinction arises between the SRU and the NAIRU (see Box: "Distinction between the SRU and the NAIRU"). While the former still depends only on structural factors, the NAIRU has dynamics of its own and will, therefore, deviate temporarily from the SRU in response to both structural and aggregate demand shocks. One implication is that inflation will continue to rise if the actual unemployment rate is below the NAIRU, even if it is above the SRU. Aggregate

1. Macroeconomic policies may have some effect on the SRU by increasing certainty about the future and reducing economic variability, thereby reducing the amount of frictional unemployment. In addition, fiscal policy measures can have structural implications (for example non-neutral tax increases) which may also affect the SRU. However, policy-induced purely nominal changes in aggregate demand would have no effect on the SRU.

demand management policies to reduce unemployment to the SRU must, therefore, take care not to outrun the dynamics of the NAIRU, an observation that has led to the term "speed-limit effects" to describe the slow return of the NAIRU to the SRU following a shock.

4. Virtually all OECD countries implicitly or explicitly use the NAIRU framework as a general reference in setting and discussing their policies. As a quantitative indicator, the measured NAIRU or SRU provide a direct gauge of the extent of labour-market imperfections and, thus, the scope for structural policies. However, the role of these indicators play in practice in macroeconomic analysis and macro-policy setting appears to differ across countries. In general, this role seems to be more limited in Europe, especially countries with fixed exchange rates, than in other OECD countries, in particular the United States.

Distinction between the SRU and the NAIRU

1. The conceptual distinction between the NAIRU and the SRU can be illustrated in a simple fashion using an inflation equation that can be thought of as a version of the Phillips curve.

$$Dp = Dp_{-1} - b1(U-SRU) - b2DU + z \qquad [1]$$

In this equation, p is the logarithm of the aggregate price level, U is the unemployment rate, z captures various factors that could influence inflation independently from the degree of tightness prevailing in the labour market;
$DU = U - U_{-1}$ is the change in the unemployment rate and $Dp = p - p_{-1}$ represents inflation.

2. The SRU, or Structural Rate of Unemployment, is essentially determined by structural factors and is considered as being independent of the cyclical influence of aggregate demand fluctuations. However, for various reasons, the unemployment rate consistent with stable inflation, or NAIRU, may deviate temporarily from the SRU when labour markets are affected by structural or macroeconomic shocks.

3. In the context of equation [1], this possibility is introduced by adding the change in the unemployment rate (DU) on the right-hand side of the equation which permits a derivation of the NAIRU. Defining the NAIRU as the unemployment rate consistent with stable inflation (i.e. assuming $z = 0$ and $Dp = Dp_{-1}$), one obtains the following relationship between the NAIRU, the SRU and last period's observed unemployment rate:

$$NAIRU = (b1/(b1+b2))*SRU + (b2/(b1+b2))*U_{-1} \qquad [2]$$

4. The more sensitive the NAIRU is to purely cyclical factors (i.e. the bigger the size of b2 relative to b1), the wider the divergence between the NAIRU and the SRU will be (for a given divergence between the observed unemployment rate and the SRU) and the longer this divergence can be expected to prevail. This phenomenon is commonly referred to as the **"speed-limit"** effect.

5. In an extreme case, the speed-limit effect becomes an **hysteresis** effect if the level of unemployment exerts no influence on inflation which then depends only on the change in unemployment ($b1 = 0$). In this hypothetical situation, the NAIRU being entirely determined by cyclical factors (captured by the lagged observed unemployment rate), the concept of SRU is no longer well-defined.

5. Monetary authorities in the United States refer to the NAIRU or the SRU estimate with explicit recognition of speed-limit effects when discussing the required stance of monetary policy, while monetary authorities in most European countries appear more reluctant to refer to any specific estimate of the NAIRU. Moreover, while in countries adhering to the Maastricht treaty fiscal targets are set as ratios of actual GDP, several other countries including Australia and Norway discuss the appropriateness of their fiscal policy in terms of cyclically-adjusted budget balances. Utilisation of macroeconomic policies appears also to differ between European countries with fixed exchange rates and a number of other OECD countries when they are in a similar phase of the cycle. For example, countries like the United States, Japan and Norway tend to respond much more aggressively than Germany or France whenever a labour market gap opens up, in an effort to stabilise the real economy. In addition, some countries (e.g. Germany, Switzerland) seem much more determined than others to prevent situations of excess demand by tightening monetary policy immediately and aggressively as soon as there are any indications of a pick-up in inflationary pressures or inflation expectations, even in situations of relatively high unemployment.

6. This paper aims at discussing the reasons for these difference across countries, and especially what characterises the European economies compared with other economies, as regards the utilisation of the NAIRU indicator for the formulation of macro-policies (part II) and the utilisation of macro-policies for addressing their unemployment problem (part III). The conclusions of this analysis are presented in part IV of this paper.

II. The use of the NAIRU for the conduct of macro-policy

7. There are a number of possible reasons which help to explain why, despite principal agreement on the general analytical framework, certain countries appear more readily than others to use quantitative estimates of the NAIRU for the formulation of their macro-policy. These reasons can be traced to perceived differences in the precision of actual NAIRU estimates and the closeness of the unemployment gap-inflation link. These issues are now explored in more detail.

Measurement issues

8. The NAIRU is not directly observable. To make the concept operational, it has to be quantified. Numerous methods of estimating this structural unemployment rate have, therefore, been developed. Usually based on an analysis of the effects of the NAIRU on observable variables like inflation,

wage trends, company margins or the unemployment rate, they can be divided broadly into two main categories. The first group of so-called "structural methods" involves modelling wage and price determination mechanisms at an aggregate level, on the basis of economic agents' behaviour. The NAIRU is then derived from these estimated equations, assuming that markets are in equilibrium[2]. The second group of "direct methods" postulates the existence of a NAIRU but does not try to specify or identify the underlying behaviour of economic agents. The NAIRU is, in such a case, derived from its supposed effects, based on observation of unemployment and/or inflation, by decomposing the unemployment series into a trend (NAIRU) component and a residual.

9. As a general rule, the NAIRU is a concept that is difficult to measure precisely for all countries, irrespective of the measurement method chosen. Point estimates vary greatly and are subject to a large margin of uncertainty[3]. Even in the United States, for which NAIRU estimates are thought to be relatively precise, Staiger et al. (1996), for example, have put the 95 per cent confidence interval at plus or minus 1.3 percentage points, using direct measurement methods. Some estimated confidence intervals for NAIRUs in European economies using structural measures tend to be so large that they cover the whole historical range of observed unemployment rates, leading the European Commission (1995) to seriously question the NAIRU as a useful policy indicator in practice[4]. Several recent studies come to similar conclusions for the Netherlands (van der Horst et al., 1996), Finland (Holm and Somervudrie, 1996), Austria (Pichelmann, 1996) and the United Kingdom (Melliss and Webb, 1996), even if in this latter case this point is made point more cautiously.

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2. Actually, the concepts of NAIRU and equilibrium unemployment rate of the labour market need not to be stricto sensu equivalent. The equilibrium unemployment rate can be defined as the unemployment rate consistent with no inflation surprise (i.e. inflation expectations fulfilled); but the absence of inflation surprises does not necessarily correspond to stable inflation as this correspondence depends on the expectation formation mechanism. In the long run, however, these notions are likely to be equivalent as, with monetary policy aiming at maintaining a low and stable inflation rate, a prolonged period of absence of inflation surprises will finally mean that inflation stabilises (and vice versa).

3. As a general rule "direct" NAIRU measures tend to give more precise results, since they typically involve less estimated parameters than structural methods. On the other hand, some direct estimation results (e.g. those based on filtering methods) do not permit an objective evaluation of their precision (i.e. the computation of confidence intervals); and only structural measures provide information on NAIRU determinants.

4. The extremely large confidence intervals of NAIRU estimates in the Commission paper appear to be over-estimates (at least partly) due to the mechanical calculation of confidence intervals which ignores the covariance between estimated parameters.

10. Given the size of the measurement uncertainties determined by these technical analyses, it appears legitimate to wonder if the NAIRU indicator can be of any practical use for macro-policy conduct in any OECD country. In fact, the large confidence intervals computed for statistical NAIRU estimates mainly underscore the fact that when it comes to policy making, the use of econometrics without judgement is limited. In practice, economic decision making always occurs in an environment of uncertainty, and the influence of this uncertainty on decision making is a complicated matter. It depends in particular on the costs of inflation relative to the cost of unemployment, on the adjustment costs towards the targets fixed by authorities, and on the interaction between the policy decisions and the information about the level and the evolution over time of the NAIRU that can be inferred from their results[5]. In this context, the selection of a 95 per cent confidence interval is likely to be excessively ambitious. In virtually no country would the authorities seriously believe that the NAIRU is actually close to either the lower or the upper bound corresponding to typical estimates of the 95 per cent confidence interval[6]. Estimated with a 68 per cent confidence interval, the uncertainty surrounding the NAIRU in Staiger et al. (1996) would be reduced to about plus or minus 0.6 percentage points. In addition, the appraisal of the quantitative importance of this precision problem may also vary according to studies. A recent European Commission analysis (1996), based on direct measurement methods, put the 95 per cent confidence interval of the NAIRU for the United States at plus or minus 0.6 percentage points, significantly less than estimated by Staiger et al. (1996).

11. Nevertheless, available empirical studies suggest that a quite important difference exists in terms of precision of the NAIRU estimates between the United States and the European countries, independently of the method used (European Commission, 1996) [7]. An explanation of this phenomenon is

5. A discussion of this question is provided in Braun and Chen (1996).

6. This scepticism is also justified by the limits of a reduced-form econometric approach to measure the NAIRU. The instability in the inflation-unemployment link on which direct NAIRU estimates are based may, to a large extent, be due to the volatility of inflation expectations. Imposing a fixed lag and coefficient structure on lagged inflation terms assumes a constant expectation formation process, and the actual volatility in this process may then "show up" in other parts of the estimation equation, translating into large confidence intervals for the NAIRU estimate. If this is the case, other direct estimation methods (like the OECD NAWRU estimates, described in Giorno et al. (1995)), which do not rely on regression analysis, may well be a preferable estimation method , even though it is impossible to compute a confidence interval for the resulting estimates.

7. According to the European Commission study, the 95 per cent confidence interval obtained with a direct estimation approach would be of plus or minus 0.6 per cent for the United States, while it would reach plus or minus 2.2 and 3.1 per cent respectively for the United Kingdom and Germany, and plus or minus 3.5 and 4.6 per cent respectively for France and Italy.

provided by Staiger et al. (1996) who show that the variance of NAIRU estimates tends to be the larger the stronger the trend increase in the NAIRU. This trend increase is a distinct feature of many European countries, contrary to what can be observed for the United States (Table 1). In other words, it appears that the characteristics of the functioning of the European labour markets, which explain in large part the trend increase of the NAIRU over the last 20 years (see below), are also at least partly the source of the measurement problem of this indicator.

12. Another serious problem attached to NAIRU estimates as an indicator for macro-policies is that they are necessarily backward-looking (based on historical data), while for the conduct of these policies one would ideally want to know what the NAIRU will be in the future. This point is particularly relevant for a number of European countries, like the United Kingdom, Italy and Denmark, who have introduced important structural reforms of their labour markets: by how much will the structural unemployment rate and the NAIRU be affected by individual structural reform measures and how long does it take for these reforms to translate into a lower structural rate? These difficulties, too, explain in part the limitations affecting the usefulness of the NAIRU indicator for the formulation of macro-policy in a number of countries.

13. Obviously, the less precise a NAIRU estimate is, the less useful it will be in policy formulation and the less policy-makers will be willing to rely on it. In particular, any imprecision in NAIRU estimates will translate into imprecise measures of the output gap where the latter uses the NAIRU as an input, and this imprecision will also affect cyclical adjustments, for example of budget balances, based on such gap estimates[8]. This is likely to explain partly why many countries, especially European, are reluctant to use structural fiscal indicators in order to assess their public finance positions and to define their fiscal targets. Especially given that even if the NAIRU could be measured precisely, a question remains whether the appropriate cyclical adjustment of fiscal balance should be based on the NAIRU or the SRU[9].

14. Concerning monetary policy management, the measurement problem appears, however, less crucial in various respects. Indeed, the NAIRU is not

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8. However, this does not necessarily imply that the estimation of output gaps should not make use of the NAIRU unless it can be shown that alternative output gap measures are more precise than those using the NAIRU; the relevant choice criterion is relative, rather than absolute, precision; but the uncertainty surrounding such estimates should be taken into account when basing important policy decisions on them.

9. The cyclically-adjusted budget balances computed by the Secretariat are based on output gaps using NAWRU estimates which are akin to the NAIRU (i.e. a short-term equilibrium) concept.

used as a "policy threshold" which, when reached, leads to an abrupt change in the policy setting. Lags between policy decisions and when specific policy measures actually affect the economy render such an approach inappropriate. This explains why, in practice, it is not so much the level of unemployment in relation to the NAIRU (whatever its estimated level) which determines policy action but the change in output indicators and unemployment. These monthly numbers convey information on the pace at which the economy is expanding. If this pace is considered unsustainable, implying an eventual collision with the potential output and/or NAIRU thresholds, monetary policy is adjusted to avoid overshooting and achieve a "soft landing". Periodic information on inflation and output - in fact all conjunctural data - are interpreted and acted upon in much the same fashion[10].

Instability of the inflation-unemployment link

15. If the use of the NAIRU indicator for monetary policy does not appear to be excessively dependant on the precision of estimates, it must, however, take into account of the degree of stability and of the closeness of the inflation-unemployment link. Yet, the comparison of developments in the rates of inflation and unemployment - the key relationship used for the "direct" measurement of the NAIRU - shows that the link between inflation and the labour-market gap is not stable in the short term. Figure 1 illustrates this instability for the G7 countries by juxtaposing changes in half-yearly inflation data and the labour market gap as estimated by the OECD. As Figure 2 documents, the closeness of this link (as measured by the correlation coefficient) differs greatly between countries, being relatively high for the United States (-0.46) and relatively low in European countries and in Japan (-0.12), and even "wrongly" signed in the case of Italy.

16. There are several reasons which may generally explain the apparent weakness of this link between the change in inflation and the labour market gap:

– the labour market gap is not well measured (due to the difficulties of measuring the NAIRU);

10. This is consistent with the view expressed by FRB Governor L. B. Lindsey (1996) on how monetary policy operates. Similarly, Staiger et al. (1996) de-emphasise the importance of unemployment levels (and thus the unemployment gap) in deciding monetary policy actions. They argue in fact that "... a rule in which monetary policy responds not to the level of the unemployment rate but to recent changes in unemployment without references to the NAIRU (and perhaps to a measure of the deviation of inflation from a target rate of inflation) is immune to the imprecision of (NAIRU) measurement".

- inflation is not well measured[11];
- the lag structure of the relationship between the labour market gap and the changes in inflation is likely to be variable over time. This reflects that the relationship depends on a number of determinants which can be rather volatile. These determinants include:
  - the credibility of government policies and the expectation formation mechanism of private agents;
  - the type of shocks to labour and goods markets hitting the economy;
  - the degree of nominal and real rigidities prevailing in these markets;

In addition, in an open economy in which much of the domestic price level is influenced by international competitiveness and world market prices, inflationary pressure is likely to show up, at least partly, in falling profit margins and a deteriorating current balance rather than in actual inflation.

17. The large degree of openness of the economy, which typically characterises European countries, is likely to explain, at least partly, why a weaker link exists between the cyclical fluctuations observed in the labour market and the changes in inflation in Europe than in the United States. However, the strength (or the weakness) of this link results also from the functioning of the labour markets in the respective countries and in particular from the stringency of regulations (and socio-cultural behaviour, like in Japan) affecting the degree of nominal and real rigidities in these markets, and thus the employment adjustment costs. This is implicitly suggested by Figure 2 which shows that in European countries and in Japan, the correlation coefficient between changes in inflation and estimated output gaps is much stronger than that between changes in inflation and estimated labour market gaps. Hence, the output gap appears to be on average a better indicator of the cycle than the labour market gap in European countries and Japan, contrary to the United States.

18. Overall, however, the volatility in the observed link between, on the one hand, inflation and, on the other, the estimated labour-market or output gap implies that estimated gaps are not a reliable predictor of whether inflation will rise or fall in the next period. Nevertheless, on average the link between unemployment gaps and inflation dynamics clearly holds, as witnessed by the

11. Because relative price changes can show up - temporarily at least - as changes in inflation, given the way the price index is computed.

distinct cyclical pattern of both inflation and unemployment. Indeed, the closeness of the link between inflation and these cycle indicators measured at yearly frequency is much stronger than at half-yearly intervals[12]; and since alternative indicators , such as the capacity-utilisation rate in the industrial sector also pose measurement and utilisation problems, the unemployment and output gap do provide (limited) information on underlying inflation pressure. Such information is valuable, in particular in situations where asymmetric inflation responses to labour-market imbalances greatly increase the cost of policy mistakes.

III. The use of macro-policy to reduce unemployment

19. Several reasons may help to explain why confronted with the same cyclical situation, macro-policies tend apparently to be used on average more cautiously in European countries than in other OECD areas, notably the United States. These reasons can be traced to perceived differences between countries in the asymmetries in response of inflation to positive and negative labour market or output gaps combined with differences in the trade-off between macro-policy objectives of countries. More fundamentally, they result from the limits and difficulties of using of macro-policies to solve the European unemployment problem which is essentially structural. The various structural rigidities which affect a number of European countries appear to explain not only the high level of the SRU but also the more-or-less stringent speed-limit effects or hysteresis, probably asymmetric, which characterise the functioning of labour markets in these economies. As a result, pertinent structural reforms aiming at improving the adjustment capacity of the economies, and especially their labour markets, will be the most robust policies to solve the European unemployment problem, in particular to remove the structural impediments causing the effect of asymmetric hysteresis. In the shorter term, however, temporary increases in unemployment should also be minimised and not be allowed to persist because cyclical unemployment may become permanent.

Asymmetric inflation response

20. In order to formulate a macroeconomic policy which is consistent with the objective of keeping inflation low and stable it is necessary to accurately

12. The correlation coefficients between the changes in inflation and the estimated labour market gap reach -0.67 on the yearly data against -0.46 on the half-yearly data for the United States; -0.23 against -0.12 for Japan; -0.50 against -0.26 for Germany; -0.32 against -0.09 for France; -0.16 against 0.02 for Italy; -0.32 against -0.23 for the United Kingdom; and -0.50 against -0.17 for Canada. Moreover, for the whole area constituted by the G7 countries this correlation coefficient estimated using the yearly data reaches -0.71.

assess the cyclical situation of the economy. This appears to be difficult in all countries and may be especially in European countries as suggested by the previous section[13]. Yet, if account is taken of the possible existence of asymmetries in the inflation/unemployment link and of induced costs in the event of an overheating economy, the authorities will be prompted to be more cautious in using macroeconomic policy. Indeed, if the inflation response to labour-market gaps is asymmetric, then a higher variance of unemployment will tend, all else equal, to raise inflation. Thus, the unemployment rate that is needed to stabilise inflation on average will rise with the variance of unemployment. In this case, reducing the size of economic fluctuations would result in a permanent output gain, although the size of this gain would depend on the degree of convexity of the Phillips curve[14]. There are at least two concrete macroeconomic-policy implications that flow from convexity. First, governments should do whatever they can to reduce business cycle fluctuations. Second, they should lean towards disinflation, since the penalty function - the eventual unemployment costs - is asymmetric: mistakes on the up-side are more costly than those on the down-side.

21. Work by the Secretariat and others has found evidence of such asymmetry for several Member countries (Laxton et al., 1994; Turner, 1995; Debelle and Laxton, 1996). The economic importance of this risk depends on the degree of asymmetry, which has proved difficult to measure with precision. According to Turner (1995), empirical evidences of asymmetric effects measured from the output gap can be found more clearly in the case of the United States, Japan and Canada than in the major European countries, even though some signs of such effects appear to be present in Germany and France but not in Italy and the United Kingdom[15]. Other work (see, for example, Braun and Chen, 1996) question, however, the existence of empirical evidence of asymmetries in the inflation/employment link and prefer to retain the

13. In general in Europe, the cyclical position of the economy cannot be identified as easily as in the United States from the cyclical fluctuations of unemployment. In addition, the changes in inflation appear to be a less reliable indicator of the cyclical situation in Europe than in the United States, this cyclical situation being estimated either by the output gap or by the unemployment gap (see the correlation coefficients reported in Figures 1 and 2). This difference between the two regions may partly be attributed to the larger degree of openness of European countries than the United States to international trade.

14. To illustrate the order of magnitude, Turner's (1995) estimates imply that if the variance of output were reduced from historical values to zero - clearly impossible from a policy perspective - output would be on average higher by about 1 per cent. By contrast, as Lucas (1987) pointed out, in the absence of nonlinearities, the welfare gains from output stabilisation alone are minute.

15. Debelle and Laxton (1996) find, however, evidence of asymmetric effects from the unemployment gaps in the case of the United Kingdom as well as for the United States and Canada.

assumption of a linear Phillips curve in the case of the United States, even if they found some evidence suggesting that this curve may be concave. Overall, differences in the appraisal of asymmetries, in combination with differences in policy objective functions, may well lead to very different policy responses to a given estimate of the labour-market gap in different countries.

Speed limit and hysteresis effects

22. While until the late-1980s, most of the empirical studies on the functioning of labour markets in the OECD countries concluded that there was no significant evidence of hysteresis[16] and only infrequently discussed the importance and the causes of speed-limit effects, it is only in the last few years that empirical research has come to focus more on these questions. Many recent studies including those by Jackman et al. (1996), Ball (1996), Jaeger and Parkinson (1994), King et al. (1995), Karamé (1996) and Scarpetta (1996) showed that there are indeed speed-limit effects to labour market adjustment in the majority of OECD countries. Countries seem, however, to be affected in varying degrees, the United States and Japan appearing, on the whole, to be less concerned than Canada or a good number of European countries such as Germany, Italy, the United Kingdom, Belgium or Spain. In the case of Norway, Holden (1996) notes that unemployment persistence effects are very strong because of the weakness of the mechanisms whereby the economy returns automatically to equilibrium[17]. Sometimes, the degree of unemployment persistence observed in certain countries seems so marked that the existence of hysteresis is a hypothesis that cannot be ruled out. For instance, using a direct statistical approach to measure underlying unemployment, Jaeger and Parkinson (1994) find signs of hysteresis in the case of Germany, the United Kingdom and Canada, but not for the United States[18].

23. Table 2 reports some empirical results to shed light on the existence and importance of speed limit and/or hysteresis effects in the labour markets of the six major OECD countries, based on a "direct approach" where the changes in inflation are regressed on the level of the unemployment gap and the change in

16. A major exception being, of course, the Blanchard and Summers study (1986) on European unemployment.

17. The notion of persistence as defined here covers both hysteresis mechanisms and strong speed-limit effect when combined with high sacrifice ratios. Both kinds of effects are likely to become observationally equivalent from the point of view of policy makers.

18. According to these authors' estimates, a 1 point rise in the rate of cyclical unemployment results in a permanent 0.2 point increase in the unemployment rate. However, other empirical studies (e.g. Elmeskov, 1993 and Blanchflower and Oswald, 1995) suggest that the level of the unemployment gap (and not only changes in the gap) exerts some influence on the level of the real wage in most OECD countries, which is inconsistent with unemployment hysteresis.

the actual unemployment rate. These tests, on which more details are provided in the Annex, tend to confirm the results of empirical studies reported above, suggesting that speed-limit effects appear to be important in the labour markets of all countries reviewed here. In Germany, Italy, the United Kingdom and Japan, the persistence is such that it becomes very difficult to distinguish statistically between strong speed-limit effects and hysteresis given the limited size of the sample. These results seem relatively robust to various sensitivity tests. Finally, it appears that when we use output gaps (and the change in output) rather than labour-market gaps, the evidence of hysteresis and the importance of speed-limit effects is significantly diminished.

24. From a policy point of view, hysteresis implies that the NAIRU has no tendency to converge to a well-defined SRU (non-existent in a hysteresis world, see the box) but, rather, that equilibrium will be re-established by the NAIRU moving towards the actual rate of unemployment so that there can be a permanent trade-off between inflation and unemployment (Blanchard and Summers, 1986) [19]. In this framework, the policy usefulness of the NAIRU concept is greatly reduced, or even disappears. Key policy concepts like the cyclically-adjusted budget deficit will become meaningless, complicating the discussion and appraisal of medium-term sustainability of fiscal policy and of the role of built-in stabilisers. However, if the permanent unemployment-inflation trade-off implied by hysteresis is symmetric, any policy mistake can be easily offset by reversing the policy action to return to the original situation. Likewise, the negative employment effects of adverse shocks can be offset by active demand management without causing a permanent acceleration of inflation.

Asymmetric hysteresis

25. If one retains as valid the assumption of (symmetric) hysteresis in certain European economies, the prudence characterising the use of macro-policy in these countries may appear paradoxical given the unemployment problem they are facing. In fact, this cautious macroeconomic management can be more easily explained if one takes into account that the strong speed limit or even hysteresis effects apparently characterising the functioning of the labour market of these European countries are likely to be asymmetric: the NAIRU tends to rise with negative shocks but does not fall (or falls less) with positive shocks, especially those induced by macro-policy.

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19. In practice, a NAIRU concept (but not a SRU) can be defined even when there is hysteresis. Thus, an alternative characterisation of the hysteresis view is that movements in the NAIRU reflect multiple labour-market equilibrium and that the NAIRU is, therefore, path dependent, with no tendency to return to a long-term equilibrium rate determined by structural factors alone.

26. Three possible reasons for hysteresis have generally been identified in the literature: the existence of insider-outsider mechanisms, the existence of a deterioration of human capital of the unemployed and the existence of capacity constraints[20]. Yet, two of these underlying causes of hysteresis will tend to make hysteresis asymmetric[21]: in the case of insider-outsider mechanisms, where wages are set to stabilise employment at its current, post-shock, level and in the case where the human capital of workers who lose their jobs may deteriorate over time to the point where they become de facto unemployable, the business cycle will potentially have a ratchet effect on the NAIRU. Strong insider/outsider mechanisms may lead aggregate demand expansion induced by macro-policy to be reflected in wage increases rather than more employment when it is anticipated by agents; and the unemployed will not be able to take advantage of improved economic conditions if the decay in their human capital cannot be reversed quickly enough[22]. In both cases, the unemployed exert no effective downward pressure on wages, implying that expansion of aggregate demand will lead to an increase in inflation rather than employment.

27. The evolution of unemployment rates over time in many European countries is, in fact, reminiscent of such an asymmetric hysteresis phenomenon. Some empirical tests aimed at verifying the plausibility of this hypothesis for the six major OECD countries have then been carried out. For this purpose, two kind of tests have been performed aiming to distinguish two different operating regimes of the economy, depending on whether unemployment is rising or falling. The first test is based on the estimation of a simple Phillips-type reduced-form equation in which the positive and negative changes in unemployment have been introduced separately with their corresponding values of the unemployment gap; the second test aims at identifying the existence of asymmetries under the assumption of hysteresis, for those countries for which the hysteresis hypothesis cannot be rejected. In this case, the positive and negative changes in unemployment are separately introduced in the equation with no unemployment gap level effect (see the Annex for more details).

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20. See Lindbeck and Snower (1984), Blanchard and Summers (1986) and Cross (1988).

21. According to the third cause, inflation is determined by capacity constraints, i.e. there is too little physical capital to achieve full employment at going wage rates due to earlier cyclical weakness of fixed investment and real wage stickiness and/or high real interest rates.

22. The assumption of asymmetric hysteresis resulting from a decay in human capital of the unemployed gives a quite convincing explanation of trend unemployment in Europe. This trend would result from the interaction of the long disinflation experienced during the eighties, which led to a rise in cyclical unemployment, with the long duration of unemployment payment benefits, which have given the jobless less incentive to seek employment and reduced their link to the labour market. In this case, it would be reasonable for policy-makers to prevent cyclical unemployment to persist too long.

28. The first test (Table 3) shows that in the case of France the inflation effect of the unemployment gap level is only significant when unemployment falls while only the change of unemployment appear to have a significant effect on inflation when unemployment rises. France is the only case among the six major countries for which this test detects such kind of asymmetric hysteresis: the hysteresis framework appears to be the more relevant framework when unemployment decreases whereas the NAIRU model fits better when unemployment falls. For the United States, contrary to France, it appears that the inflation effect of the unemployment gap is stronger when unemployment increases rather than when its falls[23]. For Germany, Italy, Japan and the United Kingdom, countries for which the hysteresis hypothesis had not been rejected by the initial tests (Table 2), introducing separately the episodes of rising or falling unemployment is inconclusive. For two of these countries, however, Germany and Italy, the test of asymmetry under the assumption of hysteresis (Table 4) shows that the inflation effect of a reduction in unemployment is stronger than the disinflation effect of a higher unemployment rate, which validates the expected asymmetric hysteresis property (even though it is different from the one observed for France). Overall, in three out of the four major European countries, empirical evidence tends to confirm the hypothesis of existence, in one form or the other, of asymmetric hysteresis even if one must remain cautious about the interpretation of these results[24].

29. The permanent inflation-unemployment trade-off implied by unemployment hysteresis will be hard to exploit by systematic demand management policies if it is asymmetric, as is plausibly the case[25]. Therefore, in countries where labour-market adjustment appears to be particularly sluggish (e.g. France, Germany, Spain and most other European economies), it seems preferable to concentrate on structural reform aiming at increasing markets' capacity to adjust quickly to changing circumstances, rather than to focus on the

23. Such a result seems consistent with those reported in Braun and Chen (1996).

24. In the case of the United Kingdom and Japan it appears that one observes the inverse effect to those estimated for Germany and Italy. These results, apparently counter-intuitive in the case of the United Kingdom, must, however, be interpreted with care especially for this country where broad structural reforms of the labour market have been implemented over the last years. Moreover, given the limited size of the sample and the simple reduced-form equation used, the asymmetric effect detected depend only on a limited number of episodes. It could then be, for instance, the consequence of asymmetric shocks to which the economies have been submitted rather than asymmetry resulting from the functioning of the markets.

25. The kind of asymmetric hysteresis identified in the case of France appears more stringent than the one which might affect Germany or Italy. Indeed, in the case of France, the negative shocks tend to raise the NAIRU but the positive shocks do not lower it whereas in the case of Germany and Italy the positive shocks lower it less.

design of optimal macro-policies that take the degree of unemployment persistence as given and immutable.

Importance of structural factors

30. As a rule, the studies agree on the importance of institutional and structural factors in explaining the inter-country variation in actual unemployment rates even though it is difficult to decide on the basis of formal empirical tests to what extent the highly-persistent changes in unemployment that have been observed in many OECD countries are primarily due to long-lasting speed-limit effects or to increases in the structural rate of unemployment[26]. According to Layard et al. (1991), Jackman et al. (1996), Scarpetta (1996) these structural variables can not only explain a substantial proportion of the inter-country differences in SRU levels but also cross country differences in labour market adjustment speeds. Key structural determinants that have been identified include: the duration and level (relative to market wages) of unemployment benefits; the strength of unions; the degree of centralisation of the wage-bargaining process on the employer side; job-protection legislation; taxes that drive a wedge between firms' labour costs and workers' pay; and some types of active labour market programmes.

31. It follows that the implementation of a range of structural reforms to labour and product markets constitutes the most promising approach to achieve sustainable reductions in unemployment under all the competing explanations for persistently high unemployment. The nature of the required policies is well known and they were laid out in the OECD *Jobs Study* and in the follow-up document, *Implementing the Jobs Strategy*. Such reforms must also be accompanied by macroeconomic policy that aims at fully utilising the scope for increased output (and thus employment) created by structural reform, while ensuring medium-term price stability.

26. In the latter case, it is difficult to clearly distinguish between changes in the SRU due to changes in its structural determinants and/or their interaction with a changing economic environment on the one hand, or to hysteresis effects on the other. There may be complex interactions between various structural changes that can obscure the effect on the NAIRU of any single one of them. Indeed, there may also be adverse interactions between unchanged structural factors and changes in the broader economic environment, like increased frequency and/or severity of shocks (Ljungqvist and Sargent, 1996), the slowdown in productivity growth or increased international competition and capital mobility.

The weakness of self-equilibrating mechanisms

32. The importance of co-ordination of structural and macroeconomic policies to reduce unemployment in Europe should not be under-estimated if, as suggested by several recent studies, the mechanisms whereby the economy returns to equilibrium in the wake of cyclical labour market disequilibrium are weak. The convergence process of unemployment towards the NAIRU following a shock would be slowed by the existence of nominal and real rigidities in wage- and price-setting mechanisms. If this is the case, one should stress the importance of the recourse to active macroeconomic policy during cyclical downturn to prevent cyclical unemployment to transform into long-term unemployment leading finally to a worsening of already deep structural problems. A similar question exists for countries which have implemented structural adjustments of their labour markets: should macro-policy aim at exploiting the scope for increased output (the size of which is uncertain) or should policy makers rely on the (improved) self-adjustment mechanisms of the economy, thus reducing the risk of policy-induced inflationary pressures?

33. If it is likely that an excessively restrictive macro-policy may induce in the long run negative structural effect given the existing institutional rigidities affecting the functioning of markets, the recourse to macroeconomic policies also raises the question of the availability or the choice of instrument to be used (fiscal or monetary). In view of the state of public finances in virtually all OECD countries, fiscal policy is unlikely to be in the current circumstances, an appropriate instrument to stimulate the economy. Expansionary fiscal policies are likely to be ineffective as a means of reducing unemployment because of the crowding-out effects of interest rates or the exchange rate. This leaves monetary policy. That option is limited, however, for countries which have exchange-rate commitments and in such cases necessitates increased co-operation between countries. In certain countries (Norway, Italy), monetary policy can usefully be complemented by an income policy which co-ordinates agents' inflationary expectations and thereby strengthens the mechanisms which restore economic equilibrium. This sort of policy is difficult to implement in many countries, however, because of the decentralised nature of wage bargaining.

IV. Conclusions

34. The NAIRU is a useful concept but its measurement is difficult since it cannot be directly observed. Margins of error attached to its estimates are substantial; they differ from country to country and across time. This fact limits the usefulness of the NAIRU for the purposes of macroeconomic policy, both monetary and fiscal. In practice, the uncertainty attached to NAIRU estimates

and to the instability of the inflation-unemployment link implies that this indicator has to be used with caution, especially in European countries where the NAIRU is not stable and where unemployment variations are not closely related to cyclical fluctuations of output, partly as the result of an insufficient flexibility of the labour markets. Estimates of the NAIRU should therefore be updated frequently to make sure they incorporate the latest information. For day-to-day policy decisions, however, the NAIRU will be only one among many relevant (although imperfect) indicators, complementing the information flow from actual labour market, inflation and output developments. Despite its shortcomings, the NAIRU may nevertheless play an important role in the design of a coherent macro-economic policy strategy and as an aid in communicating this strategy effectively.

35. The secular increase in NAIRUs in many European countries is unmistakable, however, and in this sense the NAIRU has proved useful as a guide to structural policy. An important point is that a number of structural factors appear to explain not only the rise in the structural component of the NAIRU but also speed-limit effects and, where it may exist, hysteresis which seems to be asymmetric in a number of European countries. In all these cases, structural policies are essential to bring about a sustainable improvement of the employment situation.

36. On the other hand, macroeconomic policy can only play a limited role to reduce the existing unemployment problem in Europe, even though it may be useful in order to avoid its worsening. Monetary policy in particular should aim at reducing the size of economic fluctuations and err on the side of caution if signs of asymmetry can be detected. Indeed, policy errors leading to higher inflation could then be costly to correct. Moreover, despite the marked unemployment persistence effect which characterises a number of European countries, the apparent permanent inflation-unemployment trade-off implied by hysteresis will be hard to exploit by systematic demand management policies if they are asymmetric, as is plausibly the case. In this situation, the NAIRU rises with a negative shock but does not fall (or falls less) with a positive shock. The policy implications are that temporary increases in unemployment should be minimised and not be allowed to persist because cyclical unemployment may become permanent. In the longer run, structural reform is needed to remove the structural impediments underlying the ratchet effect of asymmetric hysteresis.

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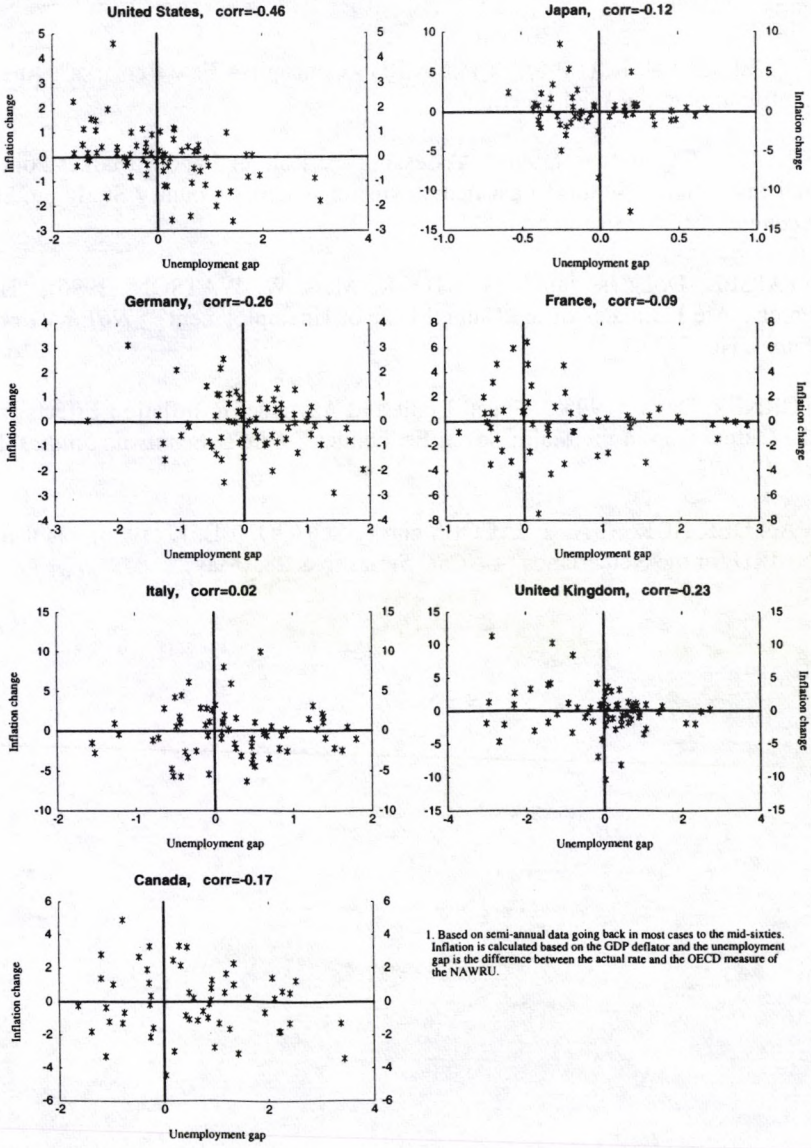
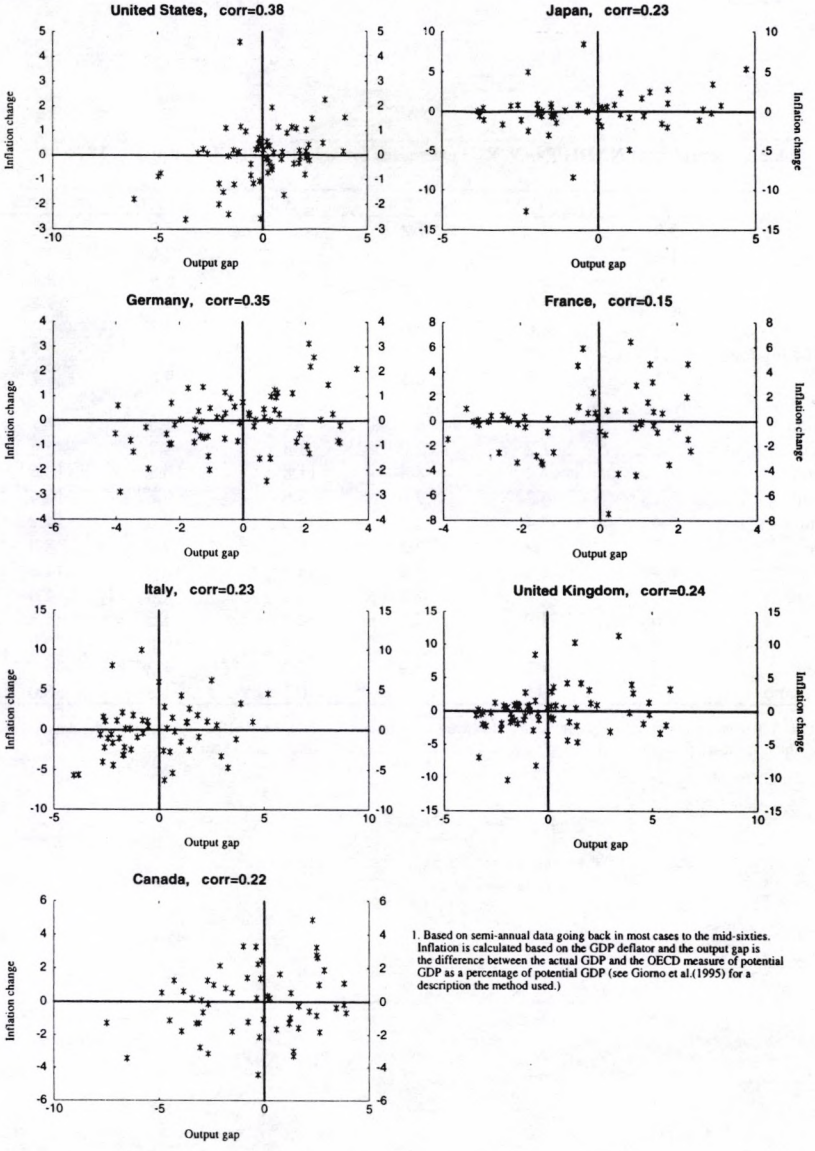
Figure 1 : Change in the Rate of Inflation vs the Level of the Unemployment Gap in the G7 OECD Countries (1)
(in percentage)



1. Based on semi-annual data going back in most cases to the mid-sixties. Inflation is calculated based on the GDP deflator and the unemployment gap is the difference between the actual rate and the OECD measure of the NAWRU.

Figure 2 : Change in the Rate of Inflation vs the Level of the Output Gap in the G7 OECD Countries (1)
(in percentage)



1. Based on semi-annual data going back in most cases to the mid-sixties. Inflation is calculated based on the GDP deflator and the output gap is the difference between the actual GDP and the OECD measure of potential GDP as a percentage of potential GDP (see Giorno et al.(1995) for a description the method used.)

Table 1. **Secretariat NAIRU/NAWRU[1] estimates for selected OECD countries, 1970-95**

	1970	1975	1980	1985	1990	1995
United States	5.3	7.2	7.2	6.5	5.8	5.8
Japan	1.4	1.7	2.5	2.5	2.5	2.7
Germany	1.0	2.3		7.1	6.9	9.2
France	2.4	3.3	6.7	8.9	9.3	9.7
Italy	4.4	4.8	6.0	8.2	9.7	9.0
United Kingdom	2.4	4.0	7.4	10.2	8.4	7.2
Canada	5.1	6.8	8.5	8.7	9.0	8.7
Australia	1.9	4.1	6.4	7.9	8.3	7.7
Austria	..	1.2	2.0	3.8	4.9	5.4
Belgium	..	4.1	8.8	11.8	10.8	10.6
Denmark	1.1	4.3	7.6	8.6	9.6	10.4
Finland	2.4	4.4	5.5	5.5	8.0	14.9
Greece	1.7	1.7	3.2	6.4	7.0	8.0
Ireland	6.4	6.4	6.4	14.3	16.0	14.0
Netherlands	..	2.4	5.2	8.1	7.0	6.0
Norway	1.6	1.9	2.2	2.9	4.5	5.3
Spain	2.6	3.7	10.7	18.4	19.8	20.0
Sweden	1.7	1.7	1.9	2.2	3.2	6.5
Switzerland	0.5	0.5	0.5	0.5	1.3	3.0

1. The NAWRU is the unemployment rate which stabilises wage inflation, while the NAIRU is defined as the unemployment rate which stabilises price inflation.

Table 2. Test of hysteresis under the assumption of symmetry

Impact of the unemployment gap and the change in the unemployment rate on inflation
(based on GDP deflator)[1]

	United States	Japan	Germany	France	United Kingdom	Italy
Sample	61H1-95H2	63H1-94H2	64H1-95H2	65H1-94H2	63H2-94H2	63H2-95H2
$\Delta^2 P_{t-1}$	-0.317	-0.371	-0.644	-0.888	-0.195	-0.350
	(2.7)	(3.1)	(5.2)	(6.8)	(1.5)	(2.9)
$\Delta^2 P_{t-2}$	--	-0.328	-0.569	-0.498	-0.101	-0.271
		(2.8)	(3.9)	(3.0)	(0.8)	(2.3)
$\Delta^2 P_{t-3}$	--	-0.185	-0.461	-0.205	-0.254	-0.233
		(1.6)	(3.0)	(1.5)	(2.1)	(2.0)
$\Delta^2 P_{t-4}$	--	--	-0.400	--	--	--
			(2.6)			
$\Delta^2 P_{t-5}$	--	--	-0.226	--	--	--
			(1.6)			
$\Delta^2 P_{t-6}$	--	--	-0.299	--	--	--
			(2.4)			
$UGAP_{t-1}$	-0.362	-2.40	-0.349	-0.832	-0.276	-0.023
	(3.0)	(1.5)	(1.2)	(2.0)	(1.0)	(0.0)
ΔU_{t-1}	-0.632	-7.05	-0.991	-1.63	-1.65	-3.19
	(2.8)	(2.2)	(1.2)	(1.5)	(2.3)	(2.7)
ΔU_{t-2}	--	--	1.95	--	--	--
			(1.8)			
ΔU_{t-3}	--	--	-2.39	--	--	--
			(2.7)			
ADJ-R2	0.21	0.20	0.33	0.44	0.11	0.15
S.E.E.	1.066	3.033	1.765	2.400	3.167	3.134
	Wald test on the joint significance of lagged UGAP parameters HO: UGAP coefficients are not significantly different from zero[2].					
P-value	0.000	0.014	0.014	0.028	0.034	0.032
	Wald test on the significance of the sum of UGAP parameters HO: sum of lagged UGAP coefficients is not significantly different from zero.					
P-value	0.005	0.138	0.228	0.053	0.312	0.818

1. Except in the case of Italy where the measure is based on the CPI.
2. As an alternative test for the presence of significant gap level effects, we re-estimated the equations after replacing the lagged change in the level of unemployment with extra lags in the level of unemployment gap. After testing for whether the coefficients associated with the lagged gap variables were jointly significant (first row with P-values reported), we tested whether the sum of the coefficients associated with the lagged gaps was significantly different from zero (second row of the P-values). A rejection of the null hypothesis that the sum of coefficient is not significantly different from zero can be interpreted as a rejection of hysteresis.

Table 3. Test of asymmetric hysteresis

Effect on inflation of the unemployment gap and the change in the unemployment rate when periods of rising and falling unemployment are introduced separately (based on GDP deflator)[1]

	United States	Japan	Germany	France	United Kingdom	Italy
Sample	61H1-95H2	63H1-94H2	64H1-95H2	65H1-94H2	63H2-94H2	63H2-95H2
$\Delta^2 P_{t-1}$	-0.294 (2.5)	-0.416 (3.3)	-0.655 (5.2)	-0.893 (6.9)	-0.263 (2.0)	-0.350 (2.9)
$\Delta^2 P_{t-2}$	-	-0.363 (3.0)	-0.531 (3.5)	-0.483 (3.0)	-0.108 (0.9)	-0.272 (2.3)
$\Delta^2 P_{t-3}$	-	-0.205 (1.7)	-0.470 (3.0)	-0.203 (1.5)	-0.223 (1.8)	-0.242 (2.1)
$\Delta^2 P_{t-4}$	-	-	-0.424 (2.7)	-	-	-
$\Delta^2 P_{t-5}$	-	-	-0.256 (1.7)	-	-	-
$\Delta^2 P_{t-6}$	-	-	-0.323 (2.5)	-	-	-
$GAPPOS_{t-1}$	-0.456 (2.3)	-0.835 (0.4)	-0.518 (1.4)	-0.581 (1.2)	-0.383 (1.1)	-0.031 (0.0)
$\Delta UPOS_{t-1}$	-0.788 (2.1)	-12.6 (2.1)	-1.763 (1.4)	-2.912 (1.9)	-3.357 (3.0)	-1.557 (0.8)
$\Delta UPOS_{t-2}$	-	-	3.786 (2.1)	-	-	-
$\Delta UPOS_{t-3}$	-	-	-2.741 (2.0)	-	-	-
$GAPNEG_{t-1}$	-0.214 (1.3)	-2.88 (1.1)	-0.047 (0.1)	1.604 (2.1)	-0.396 (1.0)	-0.102 (0.1)
$\Delta UNEG_{t-1}$	-0.163 (0.3)	-0.216 (0.1)	-0.154 (0.1)	4.363 (1.2)	1.129 (0.7)	-5.703 (2.1)
$\Delta UNEG_{t-2}$	-	-	-0.979 (0.4)	-	-	-
$\Delta UNEG_{t-3}$	-	-	-3.473 (1.6)	-	-	-
ADJ-R2	0.213	0.249	0.320	0.465	0.134	0.235

1. Except in the case of Italy where the measure is based on the CPI.

Table 4. Test of asymmetry under the assumption of hysteresis
Effect of positive and negative unemployment changes on inflation
(based on GDP deflator)[1]

	Japan	Germany	United Kingdom	Italy
Sample	63H1-94H2	64H1-95H2	63H2-94H2	63H2-95H2
$\Delta^2 P_{t-1}$	-0.380 (3.1)	-0.717 (5.6)	-0.095 (0.7)	-0.349 (3.0)
$\Delta^2 P_{t-2}$	-0.327 (2.8)	-0.609 (4.3)	-0.030 (0.2)	-0.272 (2.4)
$\Delta^2 P_{t-3}$	-0.146 (1.3)	-0.508 (3.4)	-0.317 (2.6)	-0.242 (2.1)
$\Delta^2 P_{t-4}$	-	-0.419 (2.8)	-	-
$\Delta^2 P_{t-5}$	-	-0.265 (1.9)	-	-
$\Delta^2 P_{t-6}$	-	-0.314 (2.6)	-	-
$\Delta UPOS_{t-1}$	-10.957 (1.9)	-1.245 (1.2)	-4.949 (3.5)	-1.523 (0.8)
$\Delta UPOS_{t-2}$	-8.641 (1.5)	-2.785 (1.8)	-5.046 (2.7)	-
$\Delta UPOS_{t-3}$	-	-2.446 (1.4)	-3.724 (2.5)	-
$\Delta UPOS_{t-4}$	-	-0.012 (0.0)	-	-
$\Delta UNEG_{t-1}$	-0.602 (0.1)	-0.753 (0.3)	7.571 (3.3)	-5.808 (2.3)
$\Delta UNEG_{t-2}$	-1.586 (0.2)	-0.738 (0.3)	-11.137 (3.3)	-
$\Delta UNEG_{t-3}$	-	-1.342 (0.6)	-3.472 (1.4)	-
$\Delta UNEG_{t-4}$	-	-5.448 (2.6)	-	-
ADJ-R2	0.201	0.385	0.335	0.170
Statistical tests on the coefficients of lagged unemployment changes				
HO: coefficients on $\Delta UPOS_{t-i}$ are jointly significantly different from zero				
P-value	0.029	0.309	0.002	0.403
HO: coefficients on $\Delta UNEG_{t-i}$ are jointly significantly different from zero				
P-value	0.977	0.025	0.005	0.025
HO: sum of coefficients on $\Delta UPOS_{t-i}$ is significantly different from zero				
P-value	0.009	0.312	0.005	0.403
HO: sum of coefficients on $\Delta UNEG_{t-i}$ is significantly different from zero				
P-value	0.928	0.005	0.953	0.025

1. Except in the case of Italy where the measure is based on the CPI.

ANNEX

Test of hysteresis under the assumption of symmetry

1. The empirical tests conducted to detect the relative importance of speed-limit or hysteresis effects in the six largest OECD (Table 2) countries are based on the estimation of the following reduced-form relation between inflation and unemployment:

$$\Delta^2 p_t = \sum_{i=1}^{k} \beta_i \, \Delta^2 p_{t-i} + \lambda \, UGAP_{t-1} + \sum_{i=1}^{l} \alpha_i \, \Delta U_{t-i}$$

[A.1]

where $\Delta^2 p_t$ is the change in inflation; $UGAP = U - SRU$ where U is the observed unemployment rate; SRU is an estimate of the structural rate of unemployment and ΔU is the change in the actual unemployment rate. In theory, the finding that only the coefficients on the lagged changes in unemployment are significant is consistent with an hysteresis interpretation, given that in such cases, a permanent reduction in the inflation rate is obtained at the cost of a permanently higher unemployment rate.

2. There are many problems with the estimation of equation [1], the most important being the identification of the structural rate of unemployment (SRU)[1]. Given the uncertainties surrounding any estimate of the SRU, different approaches have been used in practice. For the results presented in Table 2 and 3, the measure of SRU was derived from the application of the Hodrick-Prescott (H-P) filter on the observed unemployment rate with a value of the smoothing parameter chosen in a way to produce a fairly smooth series of the unemployment rate. However, given the arbitrary nature of this approach, we have examined the sensitivity of the results to various smoothing parameters as well as to the case where the SRU is treated as a constant. Moreover, we have

1. Conceptually, the structural rate of unemployment (long-term equilibrium rate) should be the one used rather than the NAIRU to measure the gap in order to identify properly speed-limit effects. The reason is that in the presence of speed-limit effects, the NAIRU depends on lagged unemployment and, as a result, if the latter was used to measure the gap in A.1, the finding that coefficients on lagged ΔU are insignificant would not necessarily imply the absence of speed limit. Moreover, given the reduced form of the equation estimated, it is empirically difficult to measure with great confidence the relative importance of lagged effects of unemployment and of prices so that the results must be interpreted with caution.

examined the robustness of the method to the choice of the sample period[2], the variable used to measure inflation, and to the specification of the dynamic structure of the inflation terms included in the estimated equation[3]. While the results of these tests are not reproduced, they essentially confirm the conclusions obtained on the basis of the tests reported in Table 2.

3. In addition, an alternative specification of the proposed equation where unemployment is replaced by the output gap and the change in output has been estimated[4]. The corresponding results are reproduced in Table A.1. They indicate that, except for Germany and Japan, the coefficient on output gap is significant in all countries with a confidence level above 90 per cent. The hysteresis hypothesis, which could not be rejected in the case of Japan, Germany, Italy and the United Kingdom on the basis of the equation linking inflation to the unemployment gap (Table 2), is rejected in the latter two cases when the unemployment gap is replaced by the output gap in the inflation equation[5].

Test of asymmetric hysteresis

4. In this case, we examine the possibility that some countries may be characterised by some form of asymmetric hysteresis, i.e. that the hysteresis mechanism is stronger in the case of a rise in unemployment than in the case of a fall. The results of this test, which are reproduced in Table 3, are also based on an equation of the form similar to A.1. However, in order to test for possible asymmetry, the positive and negative changes in unemployment are introduced

2. For example, in the cases of Germany and Italy, the equations have been re-estimated on a sample ending in 1990 to ensure that the results are not significantly affected by German reunification or the end of the "scala mobile" policy, respectively.

3. For instance, inflation has been measured based on private sector wages (including social contributions) rather than on the basis of the GDP deflator or consumer prices. Moreover, the constraint of inflation homogeneity in equation A.1. has been relaxed (i.e. inflation has been introduced in level rather than first-difference form, with no constraints imposed on the sum of lagged inflation terms on the RHS of the equation). Overall, these various changes have not led to significant changes in the results.

4. In this case, the specification of the inflation equation is identical to the one above except that the unemployment gap ($UGAP$) and first-difference (ΔU) are replaced by the output gap ($YGAP$) and first-difference (ΔY).

5. It should be mentioned that in the case of Japan, little evidence can be drawn given the poor statistical performance of the equation as illustrated by the fact that output is significant in neither level nor first-difference form. On the other hand, when the output gap is measured based on a more volatile trend series, (small value of λ parameter in H-P filter) we find a significant gap coefficient, allowing for a rejection of hysteresis.

separately ($\Delta UPOS$ and $\Delta UNEG$ respectively). Moreover, the values of the unemployment gap which coincide with the periods of positive and negative changes in unemployment have also been introduced separately ($GAPPOS$ and $GAPNEG$)[6].

5. We can then verify whether the unemployment gap and/or first-difference effects are significant both in the case of a rise and a fall in unemployment. Overall, the results shown in Table 3 indicate that in the four countries where hysteresis could not be rejected on the basis of the test reported in Table 1 (Japan, Germany, United Kingdom and Italy), introducing separately the episodes of increases and decreases in unemployment does not lead to the finding of a significant gap level effect[7]. Moreover, in three of these cases (Japan, Germany and the United Kingdom), we observe that the effect of a rise in unemployment on inflation appears to dominate the effect of a fall, whereas the opposite is true in the case of Italy.

6. In the case of the United States, although a significant gap effect is found, it does not seem to be symmetric. It appears, in fact, that an increase in unemployment has an impact on inflation that is larger than that of an equivalent decline (given the state of excess demand or supply which prevails on the labour market during the respective periods of rising and falling unemployment). This type of asymmetric effect would thus be counter-intuitive[8]

7. Finally, we find that in the case of France, the unemployment gap coefficient is singificant only when unemployment is falling whereas only the change in unemployment is significant when it is rising. France is thus the only case showing some evidence consistent with this type of asymmetric hysteresis, i.e. where the hysteresis assumption applies when unemployment is rising and where the conventional NAIRU model fits better when unemployment is declining.

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6. It should be made clear that $GAPPOS$ and $GAPNEG$ do not necessarily represent positive and negative values of the unemployment gap respectively, but rather the actual values of the gap during periods of rising and falling unemployment.

7. The main results reported in Table 3 are not qualitatively sensitive to different measures of the gap based on various choices for the smoothing parameter of the H-P filter.

8. In the U.S. case, we have verified whether the results were sensitive to the introduction of dummy variables for the wage and price control measures during the Nixon era as well as for the catch-up episode that followed the end of the controls. This modification did not change the results significantly.

Test of asymmetry under the assumption of hysteresis

8. Finally, in the four countries where the hysteresis assumption could not be rejected based on the previous tests, we examine whether the effect of a change in unemployment is symmetric. In order to do so, an equation of a form similar to A.1 was estimated, with the gap variables omitted and with the positive and negative changes introduced separately ($\Delta UPOS$ et $\Delta UNEG$).

9. The results shown in Table 4 are consistent with the presence of asymmetric effects of changes in unemployment on inflation[9]. However, the nature of the asymmetry observed differs across the countries. In the case of Germany and Italy, the negative changes in unemployment have a stronger effect on inflation whereas in the Japan and the United Kingdom, the positive changes appear to be dominant. In the first two cases, the increase in inflation associated with the decline in unemployment is more pronounced than the fall caused by a rise in unemployment which corresponds to the type of asymmetry usually expected.

9. Given the inclusion of several lags in the positive and negative changes in unemployment, some tests were made to verify first, whether the coefficients associated to these lags were jointly significant (first two rows of P-values) and, second, whether the sum of coefficients is significant (last two rows of P-values). A P-value equal to 0.05 indicate a rejection of the null hypothesis with a 95 per cent confidence level. Since there is only one lag in the case of Italy, there is no difference between the two assumptions tested.

Table A.1. Test of hysteresis under the assumption of symmetry
Impact of the output gap and the change in output on inflation
(based on GDP deflator)[1]

	United States	Japan	Germany	France	United Kingdom	Italy
Sample	61H1-95H2	63H1-94H2	64H1-95H2	66H1-94H2	63H2-94H2	63H1-95H2
$\Delta^2 P_{t-1}$	-0.259 (2.2)	-0.318 (2.6)	-0.587 (4.6)	-0.900 (7.1)	-0.181 (1.4)	-0.533 (4.3)
$\Delta^2 P_{t-2}$	-	-0.331 (2.8)	-0.463 (3.1)	-0.544 (3.6)	-0.122 (1.0)	-0.298 (2.6)
$\Delta^2 P_{t-3}$	-	-0.182 (1.5)	-0.328 (2.1)	-0.299 (2.5)	-0.294 (2.4)	-0.228 (2.0)
$\Delta^2 P_{t-4}$	-	-	-0.300 (2.0)	-	-	-
$\Delta^2 P_{t-5}$	-	-	-0.152 (1.0)	-	-	-
$\Delta^2 P_{t-6}$	-	-	-0.268 (2.1)	-	-	-
$YGAP_{t-1}$	16.6 (3.2)	8.74 (1.1)	8.1 (1.3)	29.5 (2.6)	38.7 (2.8)	44.6 (2.7)
ΔY_{t-1}	13.9 (1.6)	33.2 (1.6)	16.3 (1.2)	30.8 (1.5)	3.0 (0.1)	73.9 (3.2)
ADJ-R2	0.17	0.14	0.25	0.48	0.13	0.33
S.E.E.	1.094	3.145	1.878	2.307	3.118	2.493
	Wald test on the joint significance of lagged YGAP parameters HO: UGAP coefficients are not significantly different from zero[2].					
P-value	0.001	0.111	0.142	0.007	0.015	0.000
	Wald test on the significance of the sum of YGAP parameters HO: sum of lagged YGAP coefficients is not significantly different from zero.					
P-value	0.002	0.249	0.188	0.008	0.007	0.015

1. Except in the case of Italy where the measure is based on the CPI.
2. As an alternative test for the presence of significant gap level effects, we re-estimated the equations after replacing the lagged change in the level of output with extra lags in the level of output gap. After testing for whether the coefficients associated with the lagged gap variables were jointly significant (first row with P-values reported), we tested whether the sum of the coefficients associated with the lagged gaps was significantly different from zero (second row of the P-values).

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